

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL RESEARCH
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P.I.: David T. Sandwell

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RESEARCH GRANT

GRANTEE:

The Regents of the
University of California San Diego, Scripps
Scripps Institution of Oceanography
Off. of Cont. & Grant Admin. 0210
La Jolla, CA 92093-0210

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ELECTE
APR 22 1993
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TOTAL AMOUNT OF GRANT: \$40,000.00

DUPLICATE ORIGINAL

AUTHORITY: 10 U.S.C. 2358 as amended, and 31 U.S.C. 6304.

GRANT SCHEDULE

The purpose of this Modification is to reduce the amount of the Grant to \$40,000.00 from \$485,237.00 due to budget cuts.

Effective as of the date of this Modification:

1. The total amount of this Grant is revised to read: \$40,000.00
2. The Period of this Grant is revised to read: 01 JUL 1991 through 30 JUN 1992.
3. The paragraph entitled "INCREMENTALLY FUNDED GRANTS" is deleted in its entirety.

All other terms and conditions of this Grant remain unchanged.

DISTRIBUTION STATEMENT

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Distribution Unlimited

UNITED STATES OF AMERICA
Office of the Chief of Naval Research

by

Grants Officer

MAR 17 1992

Date

REBECCA A. TAYLOR
Grants Officer

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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE April 13, 1993		3. REPORT TYPE AND DATES COVERED Final Technical Report	
4. TITLE AND SUBTITLE Charting the Remote Southern Oceans with Geosat Altimetry				5. FUNDING NUMBERS ONR N00014-91-J-1642	
6. AUTHOR(S) Dr. David T. Sandwell Dr. Walter Smith Dr. Jacqueline Mammerickx Dr. Robert Parker					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Geological Research Division Scripps Institution of Oceanography University of California, San Diego La Jolla, CA 92093-0220				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Dr. Randy Jacobson Office of Naval Research Code 1125GG 800 N. Quincy Street Arlington, VA 22271				10. SPONSORING/MONITORING AGENCY REPORT NUMBER Mr. Kevin T. Brown Defence Mapping Agency, Systems Center Code SGE MS-A45 8613 Lee Highway Fairfax, VA 22031-2138	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Public				12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The Geosat satellite altimeter has mapped the marine gravity field over nearly all of the world's oceans to a high accuracy and high spatial resolution. In the wavelength band 15 to 200 km, variations in gravity anomaly are highly correlated with seafloor topography. Since many southern ocean areas are sparsely surveyed, these new Geosat data reveal many previously unsurveyed features such as seamounts and fracture zones. The objectives of our proposed research were to: 1) Develop a method of combining geoid heights (or gravity anomalies) with shipboard profiles in order to improve bathymetric charts. 2) Evaluate the method by comparing bathymetric predictions with measured seafloor depths in two areas south of 60°S. 3) Produce an improved unclassified version of the Navy's standard bathymetric data base of the southern ocean (i.e. between 60°S and 72°S). 4) Produce an improved classified version of the Navy's standard bathymetric data base of the southern hemisphere (i.e. south of the equator). The original cost of the proposed research to be conducted over a 3 year period was \$485,237. Due to a budget cut at DMA our budget was reduced to \$40,000. Thus we completed only a small fraction of the proposed research as outlined in the attached progress reports.					
14. SUBJECT TERMS				15. NUMBER OF PAGES	
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CHARTING THE REMOTE SOUTHERN OCEANS WITH GEOSAT ALTIMETRY

ONR N00014-91-J-1642

Progress/Status Report
for the period
July 1, 1991 to September 30, 1991

Submitted to

Mr. Kevin T. Brown
Defence Mapping Agency, Systems Center
Code SGE MS-A45
8613 Lee Highway
Fairfax, VA 22031-2138

by the

Geological Research Division
Scripps Institution of Oceanography
La Jolla, CA, 93093
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Investigators:

Dr. David T. Sandwell	(619) 534-7109
Dr. Walter Smith	(619) 534-6950
Dr. Jacqueline Mammerickx	(619) 534-2166
Dr. Robert Parker	(619) 534-6150

September 30, 1991

PROGRESS

1. Walter Smith, Jacqueline Mammerickx and David Sandwell meet every other Thursday at 10:30 AM to discuss progress. The SIO group and the NRL group intend to meet at the Fall AGU meeting to compare notes and coordinate efforts.
2. Mammerickx contacted Dr. Nelius at DMA to obtain sounding sheets for Area-A (-72 to -60 latitude, 155 to 185 longitude). Smith contacted Mr. Martino at DMA to obtain a subset of the data in digital form. Two formats were provided by DMA, sounding sheets and magnetic tape. There are many profiles on the sounding sheets that are not in digital form. Mammerickx is identifying those non-digital cruises which fill major gaps in coverage; we intend to digitize these soundings and add them to our data base.
3. Tony Jones, an undergraduate student from the Computer Sciences Department, was hired to help Smith merge these DMA underway data with our existing data base (mostly LDGO and SIO digital data). This merging of all of the underway data is partially funded by this project and partially funded by Scripps.
4. We acquired 1/2 of the disk space (1.5 Gbyte) needed to put all of the LDGO, DMA, SIO and NOAA underway geophysical data on line. The second 1.5 Gbyte disk is on order and will be purchased with DMA funds.
5. Mammerickx has hand-contoured the Geosat/ERM gravity profiles in a poorly surveyed area of the South Pacific (-40 to -25 latitude, -140 to -110 longitude). This gravity map was correlated with sparse shipboard profiles in order to locate many previously uncharted seamounts. A draft of a paper on the "Foundation Seamounts" is in preparation. Mammerickx found a nearly perfect visual correlation between seamount expressions apparent Geosat gravity profiles and seamounts mapped along shipboard topography profiles.
6. Smith, in collaboration with Wessel at HIG, have further developed their system for extraction and display of underway geophysical data (Appendix A).
7. Sandwell has completed the gridding of all of the Geosat (GM and ERM) profiles south of 60°S (Appendix B). These gridded Geosat anomalies were compared with two shipboard gravity profiles to assess the accuracy and resolution of the satellite gravity; after

removing a DC-offest, the satellite and ship profiles agree to 5 mgal rms and they are coherent to 25 km wavelength. These grids will be used for the prediction of bathymetry in areas A and B.

PROBLEMS

1. Our major problem (or task) is to put all of the underway marine geophysical data into a common data base that can be accessed with a common set of programs. While Smith was a graduate student at LDGO, he set up a modern data base management system and added all of the LDGO holdings to the system. This system and all of the data were copied to our computers here at SIO. A major focus of our effort in the next few months will be to add the SIO, DMA and NOAA holdings to this system. Unfortunately these data bases have considerable overlap. Initially we intend to keep all duplicate profiles in case one of the profiles is more complete or better processed than the other.

EXPENSES

(Note the accounting is probably not current through 9/30/91 so the actual expenses for this period will be higher.)

Salaries:		\$9593.
Walter Smith	3 months @ 50%	
Jacqueline Mammerickx	3 months @ 25%	
Karen Scott	3 months @ 17%	
Tony Jones	1 month @ 50%	
Supplies		\$122.
Equipment: (on order):		
Andataco 1.5 Gbyte SCSI disk Drive, 16 Mbyte RAM		\$ 4200
Overhead:		\$ 4857.
TOTAL		\$18773.

CHARTING THE REMOTE SOUTHERN OCEANS WITH GEOSAT ALTIMETRY

ONR N00014-91-J-1642

Progress/Status Report
for the period
October 1, 1991 to October 31, 1991

Submitted to

Mr. Kevin T. Brown
Defence Mapping Agency, Systems Center
Code SGE MS-A45
8613 Lee Highway
Fairfax, VA 22031-2138

Dr. Randy Jacobson
Office of Naval Research
CODE 1125GG
800 N Quincy St.
Arlington, VA 22271

by the

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Investigators:

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Dr. Jacqueline Mammerickx	(619) 534-2166
Dr. Robert Parker	(619) 534-6150

MANPOWER UTILIZED

D. Sandwell	20% (@ no cost)
R. Parker	10% (@ no cost)
J. Mammerickx	30%
W. Smith	100%
A. Jones	21%

FUNDS EXPENDED FOR OCTOBER 1991

\$8,257.71

CURRENT STATUS

1. We have obtained digital depth soundings for Areas A and B from the following sources: SIO-holdings, Lamont-holdings, DMA-holdings.
2. We have sounding sheets for Area-A from DMA and SIO.
3. The high density Geosat data have been converted to gridded gravity anomalies for areas A and B.
4. Mammerickx has developed a hand contouring method of constructing a bathymetric chart using Geosat data and available soundings.

ACCOMPLISHMENTS/PROBLEMS

1. Walter Smith and Tony Jones have written the C-code to convert the digital underway bathymetric data into NetCDF format.
2. We have acquired enough disk capacity to put all of the underway soundings (i.e. only center beam for multibeam data) on line.

3. Sandwell produced a gravity anomaly contour map for a portion of Area A (scale of 2" per degree) for Mammerickx to use in predicting bathymetry between soundings.
4. One major problem (or task) is to put all of the underway marine geophysical data into a common data base that can be accessed with a common set for programs.
5. A second problem is to develop a 2-D algorithm for interpolating between existing depth soundings using dense Geosat altimeter profiles.

CHARTING THE REMOTE SOUTHERN OCEANS WITH GEOSAT ALTIMETRY

ONR N00014-91-J-1642

Progress/Status Report
for the period
November 1, 1991 to November 30, 1991

Submitted to

Mr. Kevin T. Brown
Defence Mapping Agency, Systems Center
Code SGE MS-A45
8613 Lee Highway
Fairfax, VA 22031-2138

Dr. Randy Jacobson
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MANPOWER UTILIZED

D. Sandwell	20% (@ no cost)
R. Parker	10% (@ no cost)
J. Mammerickx	30%
A. Jones	21%

FUNDS EXPENDED FOR NOVEMBER 1991

\$8,144.01

CURRENT STATUS

1. GeoBase GMT and Matlab4 software packages were installed on our 6 workstations. GeoBase provides easy access to all underway geophysical holdings at Lamont and SIO as well as all of the satellite altimeter data at SIO. GMT is used to manipulate the underway data and generate maps. Matlab 4 is the new beta version of matlab (signal processing and deconvolution) that handles 2-dimensional data sets. These are the basic tools that we use to retrieve, and manipulate the underway geophysical data and the satellite altimeter data.
- 2) Mammerickx has hand-contoured a large portion of region A (scale of 2in/deg) using a combination of shipboard depth profiles and gridded gravity data from dense Geosat coverage. Mammerickx has also identified important soundings that are not yet in our digital data base.
- 3) Smith and Jones are continuing to put the underway data in NETCDF format and modify the GMT software to accommodate this new format.
- 4) Smith has modified Nettleton's method to predict basement depth in 1 dimension. The new method is an iterative approach that considers both the amplitude and wavelength of the gravity anomaly when inverting for the basement.

ACCOMPLISHMENTS/PROBLEMS

- 1) Without additional funding we will not be able to continue the investigation beyond January 1, 1992.
- 2) Mammerickx will continue to identify (apparently) non digital soundings that lie in crucial data gaps. Smith will check the DMA data tapes make sure that these soundings have not already been digitized at DMA.
- 3) Sandwell and Smith will begin to test the various methods of inverting for seafloor depth.